407

Long Island Sound
REGIONAL STUDY

Soils

An Interim Report
September 1973

New England River Basins Commission

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SOILS
An Interim Report

Long Island Sound Regional Study
New England River Basins Commission
270 Orange Street
New Haven, Connecticut 06511

A summary of
reports prepared by the
Soil Conservation Service
U.S. Department of Agriculture

September 1973

FOREWORD

Long Island Sound is one of the nation's unique and irreplaceable natural resources. An almost fully enclosed arm of the ocean, it has over 1300 square miles of water surface and nearly a thousand miles of coastline. Spreading eastward along both shores from the great metropolitan center which lies at the Sound's western end, a growing concentration of increasingly affluent people make ever greater demands on this urban sea. At the same time, there is a growing feeling that the conflicting demands are destroying the Sound, and that the problems must be resolved if the Sound is to be preserved.

The Long Island Sound Regional Study is a comprehensive planning effort by the federal government and New York and Connecticut, led by the New England River Basins Commission. Assisting the Commission are professionals from many disciplines representing the federal, state and regional agencies listed on the back cover, a Citizen Advisory Committee, and a Research/Planning Advisory Committee composed of members of the region's scientific community.

THE GOAL OF THE STUDY IS TO PRODUCE A PLAN OF ACTION BY JANUARY, 1975, WHICH BALANCES THE NEEDS TO PROTECT, CONSERVE AND WISELY DEVELOP THE SOUND AND ITS RELATED SHORELANDS AS A MAJOR ECONOMIC AND LIFE-ENRICHING RESOURCE FOR THE 12 MILLION PEOPLE WHO LIVE NEAR IT.

This interim report is one of a series which outline demands placed on the Sound, its capacity to supply these demands, and the present or expected deficiencies to be overcome if it is determined that supply should meet demand. The reports provide a base for developing single purpose management plans which will evaluate the environmental and socio-economic impacts of suggested alternative solutions and propose courses of action. These management plans will be integrated into a comprehensive multi-purpose plan of conservation and development, reflecting relationships between types of demands and setting forth goals and recommendations, the means for achieving them, and a schedule of priorities. Interim reports in the series include:

Sources and Movements of Water
Water Quality
Scenic and Cultural Resources
Mineral Resources and Mining
Soils
Erosion and Sedimentation
Ecological Studies
Water Supply
Recreation
Land Use and Ownership
Flood Plains
Electric Power Generation
Transportation

SUMMARY

PURPOSE OF THIS REPORT. to introduce study participants and the public to the kinds of soils information that is available to them for the Long Island Sound (LIS) region.

HOW SIGNIFICANT IS SOILS INFORMATION IN COMPREHENSIVE PLANNING?

It varies greatly with the use --- the closely related study areas are water quality, ecological studies, water supply, erosion and sedimentation, and land use---many examples are given in this report.

WHAT SOIL PATTERNS ARE FOUND IN THE REGION?

Glaciated and glacially influenced terrain and soils predominate --- the mainland is comprised mostly of soils on glaciated uplands, of outwash terraces and of alluvial plains with complex patterns --- Long Island is comprised mostly of soils developed in morainic deposits and of sand and gravel outwash which overlie thick coastal plain sediments.

HOW CAN ONE OBTAIN MORE DETAILED INFORMATION?

Visit the local USDA Soil Conservation Service field offices (see addresses, Table 2) --- for locations of interest, find "soil association" number on the general soil map --- then read descriptions and examine interpretive usage information and engineering properties related to that number.

WHAT ARE THE MAJOR SOIL USE LIMITATIONS?

For each major soil, much information is systemically recorded concerning significant capabilities and limitations for specified uses --- major soil problems on the mainland are shallowness to bedrock, presence of slowly permeable fragipan (hardpan), steepness of slope, stoniness, droughtiness, and wetness --- major soil problems on Long Island are droughtiness, irregular topography, wetness, and in some places presence of slowly permeable fragipan.

WHAT WILL THE STUDY DO NEXT?

Work on solutions in all management areas --- soil capabilities and limitations should be reflected in the solutions along with other factors.

TABLE OF CONTENTS

	Page
FOREWORD	ii
SUMMARY	iii
TABLE OF CONTENTS	v
1. PURPOSE OF THIS REPORT	1
2. HOW SIGNIFICANT IS SOILS INFORMATION IN COMPREHENSIVE PLANNING?	1
3. WHAT SOIL PATTERNS ARE FOUND IN THE REGION?	3
Geology and soil parent materials	3
Subregional descriptions	3
4. HOW CAN ONE OBTAIN MORE DETAILED INFORMATION?	6
Soil maps	6
Soil associations	7
Soil properties	9
5. WHAT ARE THE MAJOR SOIL USE LIMITATIONS?	11
Interpretations of soils for various uses	11
Significant soil use problems by subregion	12
6. WHAT WILL THE STUDY DO NEXT?	12
Appendices	
A - Selected References	A-1
B - Glossary	B-1
C - Significant Engineering Soil Properties	C-1
D - Interpretations of Soils for Various Uses	D-1

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1.0 PURPOSE OF THIS REPORT

The purpose of this interim report is to introduce study participants and the public to the kinds of soils information that is available to them for the Long Island Sound (LIS) region. The material will be used by participants according to how it relates to their particular subject areas.

To accomplish its purpose this report --

- Suggests ways in which soils information can be useful to participants in the comprehensive study.
- Provides a general description of the geology and soil patterns in the region and in each subregion.
- Explains how more specific information can be obtained through the use of soil maps and related interpretative data on "soil associations" [1] and on soil properties.
- Identifies significant usage problems related to each major soil and to each subregion.
- Suggests what the Long Island Sound Regional Study should do next.

2.0 HOW SIGNIFICANT IS SOILS INFORMATION IN COMPREHENSIVE PLANNING?

As will be explained later in this report, existing and available soil maps can be used to show the kinds and distribution of soils within the LIS region. Based upon the major soils, a procedure will be explained for using existing information to make an assessment of the soils in terms of soil properties and use interpretations. To illustrate, Table 1 lists the subject areas (Interim reports) into which this comprehensive LIS study has been divided during its initial phase. Entries in the table suggest significant soil property and use relationships. For example, the table suggests that for the purposes of water quality planning, the following available, systematically portrayed soils information should be of particular interest:

- Water table
- Biochemical renovation potential
- Limitations for septic tank absorption fields
- Limitations for sanitary land fills
- Limitations for wastewater renovation

1 - An explanation of technical terms is given in Appendix B, Glossary.

TABLE 1. SIGNIFICANCE OF SOILS INFORMATION
IN COMPREHENSIVE PLANNING

Soil Properties and Use Interpretations	Interim Reports												
	Sources & Movements of Water	Water Quality	Scenic & Cultural Resources	Mineral Resources & Mining	Soils	Erosion & Sedimentation	Ecological Studies	Water Supply	Recreation	Land Use & Ownership	Flood Plains	Electric Power Generation	Transportation
Soil Properties:													
Depth to bedrock				X	X					X			X
Water table	X	X			X		X	X	X	X	X		
Permeability	X				X	X		X		X	X		
Subsoil erodibility classification					X	X							X
Biochemical renovation potential		X			X		X	X					
Other soil properties	X				X	X		X		X			X
Use Interpretations:													
Limitations for septic tank absorption fields		X			X			X		X			
Limitations for sites for houses with basements					X					X			
Limitations for commercial & light industry sites					X					X			
Limitations for sanitary land fill		X			X			X		X			
Limitations for waste water renovation		X			X			X		X			
Limitations for camp & picnic areas			X		X				X	X			
Suitability rating for cropland			X		X		X	X		X			
Suitability rating for wildlife habitat			X		X		X		X	X			
Woodland productivity potential					X		X			X			
Soil features affecting pond reservoir areas			X		X	X	X	X	X	X	X		
Soil features affecting transportation, utility corridors & construction sites					X			X		X	X	X	X

The decision as to whether or not a soil will be used for a specified purpose, regardless of its limitations, is beyond the scope of this soils report. At a price, almost any limitation can be overcome. It is easy to understand why in the middle of a large city, economic, locational and social factors will almost certainly override the soil use hazards and limitations. On the other hand, in more open areas anticipated for future development, it is equally easy to understand why the capabilities and limitations of the soil should be given prominent consideration.

3.0 WHAT SOIL PATTERNS ARE FOUND IN THE REGION?

3.1 Geology and soil parent materials

The Long Island Sound Study Region (LIS) and its nine subregions are depicted inside the front cover. The region embraces four physiographic provinces (1). [1] All of the study area has experienced and reflects the effects of glaciation. Of the four provinces, three are in Connecticut: the New England Upland, the Connecticut Valley Lowland and the Seaboard Lowland. The remaining physiographic province is the Coastal Plain; its sediments underlie Long Island.

The Connecticut and Westchester County parts of the study area exhibit soils developed in glacial deposits ranging from mixed boulder till to a wide variety of stratified drift. The major areas of stratified drift are in river valleys in Connecticut where sediments vary from lake bottom deposits to kames, kame deltas, terraces, eskers, and other outwash-type materials. Boulder till, however, is the dominant surficial cover between major drainage areas. The underlying bedrock is commonly granite, gneiss and schist except in the Connecticut Valley Lowland where it is basalt, reddish-brown sandstone shale or conglomerate. Bedrock is usually more than 10 feet deep throughout the area; however, rock exposures commonly occur in the uplands.

Long Island, on the other hand, has areas of soils formed in terminal moraine deposits which mark the end of the glacial advance. The moraines overlie sands and gravel of outwash origin. These sands and gravel deposits in turn overlie coastal plain sediments, 1000 to 1500 feet in thickness.

1 - Underlined numerals in parentheses are references in Appendix A.

3.2 Subregional descriptions

Subregions 1 and 2. These subregions include most of New London County and the lower half of Middlesex County. They are in the New England Upland and Seaboard Lowland physiographic provinces. The major drainageways of the area, emptying into the Sound, are the Connecticut and Thames Rivers.

The subregions consist of soils on glaciated uplands, outwash terraces, alluvial plains, inland organic deposits and tidal marsh deposits. The mineral soils have developed mostly in materials derived from granite, gneiss and schist rocks. The organic soils have developed in materials derived from various herbaceous and woody plants.

Soil patterns in these two subregions are complex with regard to slope, texture and stoniness, permeability, wetness and depth to bedrock. The soils commonly exhibit highly contrasting features within short distances. The deep upland soils are naturally stony, however, surface stones have been removed in many areas. These soils are friable throughout or they may contain a compact fragipan that is slowly permeable. They range from well drained to very poorly drained. Bedrock outcrops are common in areas of shallow upland soils. Soils of the terraces and alluvial plains have variable drainage, lack stones and are mostly highly permeable. Very poorly drained organic soils occur in scattered depressions throughout the uplands terraces and alluvial plains. Tidal marshes consist of wet organic soils common along the coastline, in estuaries and in tidal embayments.

Subregion 3. This subregion includes most of New Haven County. It is in portions of three physiographic provinces: the Seaboard Lowland, the Connecticut Valley Lowland and the New England Upland. The Connecticut Valley Lowland occupies the middle of the subregion. The major drainageways of the area, emptying into the Sound, are the Housatonic and the Quinnipiac Rivers.

The subregion consists of soils on glaciated uplands, outwash terraces, alluvial plains, inland organic deposits and tidal marsh deposits. The mineral soils of the Connecticut Valley Lowland have developed mostly in materials derived from basalt and reddish-brown sedimentary rocks. The soils of the New England Upland are formed mostly in materials derived from granite, gneiss and schist rocks. Organic soils of the area have developed in materials derived from various herbaceous and woody plants.

Soil patterns in subregion 3 are complex with regard to slope, texture and stoniness, permeability, wetness, depth to bedrock and kinds of parent material. The soils commonly exhibit highly contrasting features within short distances. The deep upland soils are naturally stony, however, surface stones have been removed in many areas. These soils are friable throughout or they may contain a compact fragipan that is slowly permeable. They range from well drained to very poorly drained. Bedrock outcrops are common in areas of shallow upland soils. This is especially true along the borders of the Connecticut Valley Lowland. Soils of the terraces and alluvial

plains have variable drainage, lack stones and are mostly highly permeable. Very poorly drained organic soils occur in scattered depressions throughout the uplands, terraces and alluvial plains. Tidal marshes consist of wet organic soils common along the coastline, in estuaries and in tidal embayments.

Subregions 4 and 5. These subregions include northwestern New Haven County and southern Fairfield County. They are mostly in the Seaboard Lowland physiographic province, however, the northern portions are in the New England Upland province. The major drainageways of the area, emptying into the Sound, are the Housatonic and Norwalk Rivers.

The subregions consist of soils on glaciated uplands, outwash terraces, alluvial plains, inland organic deposits and small areas of tidal marsh deposits. The mineral soils have developed mostly in materials derived from granite, gneiss and schist rocks. The organic soils have developed in materials derived from various herbaceous and woody plants.

Soil patterns in these two subregions are complex with regard to slope, texture and stoniness, permeability, wetness and depth to bedrock. The soils commonly exhibit highly contrasting features within short distances. The deep upland soils are naturally stony; however, surface stones have been removed in many areas. These soils are friable throughout or they may contain a compact fragipan that is slowly permeable. They range from well drained to very poorly drained. Bedrock outcrops are common in areas of shallow upland soils. Soils of the terraces and alluvial plains have variable drainage, lack stones and are mostly highly permeable. Very poorly drained organic soils occur in scattered depressions throughout the uplands, terraces and alluvial plains. Tidal marshes consist of wet organic soils along the coastline, in estuaries and in tidal embayments.

Subregion 6. This subregion includes eastern Westchester County, northern Nassau County and minor portions of Bronx and Queens. The area of Westchester County is primarily in the Seaboard Lowland physiographic province. Nassau County is in the Coastal Plain.

The subregion consists of soils on glaciated uplands, outwash terraces, alluvial plains, inland organic deposits and tidal marsh deposits. The mineral soils of Westchester County have developed mostly in materials from acid crystalline schist rocks. The soils of Nassau County are formed mostly in materials derived from granite, quartz and gneiss rocks brought in by the glacier from the north. Organic soils of the area have developed in materials derived from various herbaceous and woody plants.

Soil patterns in subregion 6 are complex with regard to slope, texture and stoniness, permeability, wetness and depth to bedrock. The soils commonly exhibit highly contrasting features within short distances. They range from excessively drained to very poorly drained. In Westchester County the soils are naturally stony and bedrock outcrops are common in areas of shallow upland soils. The deep soils of subregion 6 are friable to loose or

they may contain a compact fragipan that is slowly permeable. Soils of the outwash terraces and alluvial plains have variable drainage, but are mostly sandy and highly permeable. Very poorly drained organic soils occur in scattered depressions in the uplands, terraces and alluvial plains. Tidal marshes consist of wet organic soils along the coastline in estuaries and in tidal embayments.

Subregions 7, 8 and 9. These three subregions are entirely within Suffolk County. They are all in the Coastal Plain physiographic province. The subregions drain into the Sound and form a relatively narrow strip along northern Long Island. Fishers Island and Plum Island constitute a part of subregion 9.

Subregions 7, 8 and 9 consist mostly of soils on outwash terraces and terminal moraines. Tidal marsh deposits as well as beaches and dune land are also significant. The mineral soils have developed mostly in materials derived from granite, quartz and gneiss brought in by the glacier from the north. The tidal marsh soils have developed in materials derived mostly from reeds, sedges and grasses.

Soil patterns in these three subregions are complex with regard to slope, texture, permeability, and wetness. The soils commonly exhibit highly contrasting features within short distances. The soils on moraines are friable or loose or they may contain a compact fragipan that is slowly permeable. They range from excessively drained to very poorly drained and from loamy to sandy. Soils of the outwash terraces have variable drainage, but are mostly sandy and highly permeable. The wet organic tidal marsh soils are most common near the coastline in tidal embayments.

4.0 HOW CAN ONE OBTAIN MORE DETAILED INFORMATION?

4.1 Soil maps

General soil maps, scale 1:24,000, are available for Connecticut towns in the LIS region. They were originally prepared by the Soil Conservation Service in the sixties. Detailed soil maps, scale 1:15,840, are available for all of the New York portion of the LIS region and for several towns in the Connecticut portion (2). See Figure 1.

The LISS General Soil Map (3) is on the scale of 1:62,500. It is based on detailed soil survey maps where available and upon town general soil maps elsewhere. Figure 2 is a sample of the map.

The detailed soil survey maps and town general soil maps, the LISS General Soil Map -- and the other material to be discussed later -- are available to participants in the Long Island Sound Study. Soils information is also available to the interested public, along with interpretative assistance, at the U.S. Department of Agriculture, Soil Conservation Service Field Offices listed in Table 2.

Subregion 1:
Bozrah, East Lyme, Groton, Ledyard, Lisbon, Montville, New London, North Stonington, Norwich, Preston, Stonington, Waterford

Subregion 2:
No towns completed

Subregion 3:
Branford, East Haven, Hamden, Meriden, North Branford, North Haven, Wallingford

Subregion 4:
No towns completed

Subregion 5:
Wilton

Subregions 6, 7, 8 & 9:
Entire area completed

Figure 1. Towns and areas within the LIS region with detailed soil maps available for use.

4.2 Soil associations

The numbers on the LISS General Soil Map indicate the various "soil associations." A soil association is a landscape that has a distinctive proportional and repeating pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern. The maps showing soil associations are useful to people who want a general idea of the soils in a region or subregion, who want to compare different parts of a region or subregion, or who want to know the location of large tracts that are suitable for a certain kind of land use. The maps are useful general guides for broad land use planning such as suitability of large areas for residential, industrial, commercial, agricultural, recreational, and other uses. They are not suitable maps for planning individual developments or for selecting the exact location of a road, building, or similar structure because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management. For specific planning it is necessary to rely on detailed soil surveys along with on-site investigations.

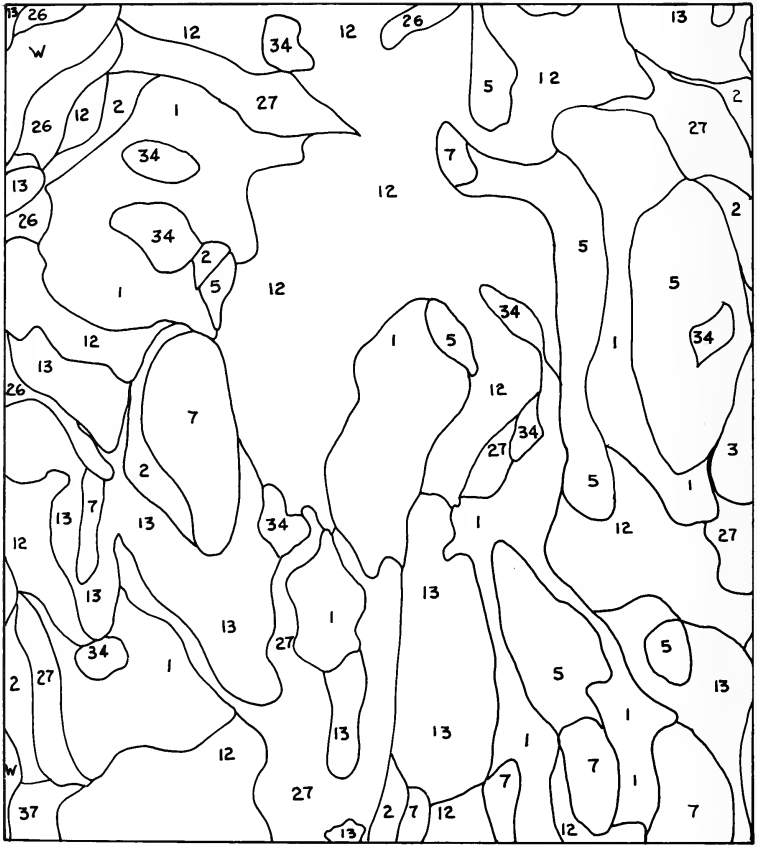

Figure 2. The LISS General Soil Map, vicinity of Groton, Connecticut.

TABLE 2. NAMES AND ADDRESSES OF SOIL CONSERVATION SERVICE FIELD OFFICES IN THE LIS REGION

CONNECTICUT

Bethel Field Office (Fairfield County), USDA, Soil Conservation Service, Rte. 6, Stony Hill, Bethel, CT 06801

Haddam Field Office (Middlesex County), USDA, Soil Conservation Service, Agricultural Center, Haddam, CT 06438

Norwich Field Office (New London County), USDA, Soil Conservation Service, 562 New London Turnpike, Norwich, CT 06260

Wallingford Field Office (New Haven County), USDA, Soil Conservation Service, Agricultural Center, Wallingford, CT 06492

NEW YORK

New City Field Office (Westchester County, Bronx and Queens), USDA, Soil Conservation Service, 23 Hempstead Road, New City, NY 10956

Riverhead Field Office (Suffolk and Nassau Counties), USDA, Soil Conservation Service, 127 East Main Street, Riverhead, NY 11901

Altogether, the LISS General Soil Map comprises 37 soil associations. They are listed in the Legend along with the proportional extent (percent) of LIS land they occupy. See Table 3. Table 3 also shows (a) that the deep soils on uplands make up well over half of the total, (b) that soils on terraces over sand and gravel make up half the remainder, and (c) that soils on floodplains, organic soils, beaches and urban land as mapped are much less extensive.

Descriptions of each of the 37 soil associations have been prepared (4). Figure 3 is an example.

4.3 Soil properties

Soil properties are used for predicting the behavior of soils when used for specific purposes. Estimates of soil properties are based on test data, field observations, past experiences and detailed examination of the soils. Refer to Appendix C for an example of information on soil properties that is available.

TABLE 3. LISS GENERAL SOIL MAP LEGEND

Map Symbol	Soil Association Name	Extent-Percent
	I - DEEP SOILS ON UPLANDS	(57.5)
	A - Over friable glacial till	(15.5)
1	CHARLTON ASSOCIATION, level through sloping	11.0
2	CHARLTON ASSOCIATION, moderately steep and steep	2.0
3	CHESHIRE ASSOCIATION, level through sloping	2.0
4	CHESHIRE ASSOCIATION, moderately steep and steep	0.5
	B - Over very firm glacial till	(20.5)
5	BROADBROOK-RAINBOW ASSOCIATION, level through sloping	5.0
6	MONTAUK ASSOCIATION, level through sloping	0.5
7	PAXTON ASSOCIATION, level through sloping	10.0
8	PAXTON ASSOCIATION, moderately steep and steep	1.0
9	RIDGEBURY-LEICESTER-WHITMAN ASSOCIATION, nearly level	2.0
10	WETHERSFIELD-LUDLOW ASSOCIATION, level through sloping	1.5
11	WILBRAHAM-MENLO ASSOCIATION, nearly level	0.5
	C - In association with shallow soils	(21.5)
12	CHARLTON-HOLLIS ASSOCIATION, gently sloping and sloping	15.0
13	CHARLTON-HOLLIS ASSOCIATION, moderately steep and steep	4.0
14	CHESHIRE-HOLYOKE ASSOCIATION, gently sloping and sloping	2.0
15	CHESHIRE-HOLYOKE ASSOCIATION, moderately steep and steep	0.5
	II - SHALLOW SOILS ON UPLANDS	(4.5)
16	HOLLIS ASSOCIATION, level through sloping	0.5
17	HOLLIS ASSOCIATION, moderately steep and steep	2.0
18	HOLYOKE-CHESHIRE ASSOCIATION, level through sloping	1.0
19	HOLYOKE-CHESHIRE ASSOCIATION, moderately steep and steep	1.0
	III - SOILS ON TERRACES OVER SAND AND GRAVEL	(25.0)
20	BERRYLAND-WAREHAM ASSOCIATION, nearly level	0.5
21	BRANFORD-ELLINGTON ASSOCIATION, level through sloping	2.0
22	CARVER-PLYMOUTH ASSOCIATION, gently sloping and sloping	1.0
23	CARVER-PLYMOUTH ASSOCIATION, moderately steep and steep	2.5
24	HAVEN-RIVERHEAD ASSOCIATION, nearly level and gently sloping	0.5
25	HAVEN-RIVERHEAD-MONTAUK ASSOCIATION, nearly level and gently sloping	3.0
26	HINCKLEY-WINDSOR ASSOCIATION, level through rolling	5.0
27	MERRIMAC-ENFIELD ASSOCIATION, level through rolling	5.0
28	PENWOOD-MANCHESTER ASSOCIATION, level through rolling	2.0
29	PLYMOUTH ASSOCIATION, gently sloping and sloping	1.0
30	PLYMOUTH-RIVERHEAD ASSOCIATION, nearly level and gently sloping	0.5
31	RIVERHEAD-HAVEN ASSOCIATION, gently sloping and sloping	1.0
32	RIVERHEAD-PLYMOUTH ASSOCIATION, gently sloping and sloping	1.0
	IV - SOILS ON FLOODPLAINS SUBJECT TO STREAM OVERFLOW	(0.5)
33	RUMNEY-LIMERICK-SACO ASSOCIATION, nearly level	0.5
	V - ORGANIC SOILS IN DEPRESSIONS AND ON TIDAL FLATS	(6.5)
34	PAIMS ASSOCIATION	3.0
35	WESTBROOK ASSOCIATION	3.5
	VI - NON-SOIL AREAS	(6.0)
36	BEACHES AND DUNELAND ASSOCIATION	2.0
37	URBAN LAND ASSOCIATION	4.0
	Total	100.0

1. CHARLTON ASSOCIATION, level through sloping

This association is distributed throughout the New England Upland and Seaboard Lowland (Fenneman, 1938) of Connecticut and New York. It is the second most extensive association in the study area. The association constitutues about 11 percent of the total acreage. The main landscape features consist of nearly level to gently sloping and sloping uplands dissected by southerly flowing streams. Slope gradients range from 0 to 15 percent. The soils of the association are naturally stony, however, some areas have been cleared of surface stones. They have developed in friable to firm glacial till derived from crystalline rocks including schist and gneiss.

About 65 percent of the association consists of Charlton soils and about 35 percent of minor soils. Charlton soils are deep, loamy, well drained, and have moderate to moderately rapid permeability. The water holding capacity available to plants is moderate. Minor soils include those of the Sutton, Narragansett, Leicester, Sun and Hollis series. Narragansett and Hollis soils occupy positions comparable to those of the Charlton soils. Sutton, Leicester and Sun soils are wetter and occupy low positions. Narragansett and Leicester soils are confined to the uplands of Connecticut. The Sun soils occur only in New York.

Stoniness and slope are the main limitations affecting use of the soils. Large tracts of land in this association have been cleared for farming, primarily in support of dairying. Some farmland has been abandoned and is idle or has changed to residential and commercial uses. In New York, most of this association is used for housing and commercial purposes. Most of the stony areas are wooded and largely unmanaged.

Figure 3. Description of soil association 1.

5.0 WHAT ARE THE MAJOR SOIL USE LIMITATIONS?

5.1 Interpretations of soils for various uses

Also available for each major soil is a table, "Interpretations of Soils for Various Uses" (5). The interpretations are based on an evaluation to a depth of about five feet. For each use, the major soils of each

association are rated in terms of the degree of limitation - slight, moderate, or severe. The degree of limitation indicates the severity of problems expected to be encountered for the specified use. Major limiting factor(s) are also listed when the soil has a moderate or severe rating. The three degrees of limitation are defined as follows:

> Slight: A rating of slight indicates that the soil has relatively few limitations in terms of soil suitability for a particular use. It is considered desirable for the named use.
>
> Moderate: A rating of moderate indicates that it is relatively more difficult and more costly to correct the natural limitations of the soil for specified uses than for soils rated as having a slight limitation.
>
> Severe: A rating of severe indicates that the specified use of the soil is seriously limited by hazards or restrictions that are very difficult and costly to overcome. A rating of severe does not necessarily imply that a soil cannot be used for the specified purpose.

Table 4 illustrates the type of information on file. It is an extract from the complete table and shows the interpretations for the first five soil associations. A brief description of each column heading of Table 4 is in Appendix D.

5.2 Significant soil use problems by subregions

Table 5 summarizes soil related use problems that are prevalent in each subregion (2).

6.0 WHAT WILL THE STUDY DO NEXT?

Upon completion of the interim reports, which deal largely with the demand-supply aspects of their subject areas, each work group will move into the management plan phase. There they will work on solutions. Information described in this interim report on soils should be used by many of the work groups. The work group on soils can be expected to be asked to develop supplementary information or interpretations on aspects of soils determined by the other work groups to be most significant in solving their problems. Particularly needed by other work groups is information about the nature and distribution of soils in suspension and deposited in streams, rivers and the Sound. This information will be especially useful to the work groups on Mineral Resources and Mining, Erosion and Sedimentation, and Water Quality.

TABLE 4. INTERPRETATIONS OF SOILS FOR VARIOUS USES

Map symbol	Soil association and major soils	Percent of association	Degree and kinds of limitations for - 1/						Suitability ratings for - 1/		Woodland productivity potential	Soil features affecting -	
			Septic tank absorption fields	Sites for houses with basements	Commercial & light industry sites	Sanitary land fill	Waste water renovation	Camp & picnic areas	Cropland	Wildlife habitat		Pond reservoir areas	Transportation, utility corridors & construction sites
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	CHARLTON ASSOCIATION, level through sloping												
	Charlton	65	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas 2/	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas	SLIGHT: 0-3% slopes MODERATE: 3-8% slopes SEVERE: 8-15% slopes, stony areas	SEVERE: moderately rapid permeability, stony areas	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas	GOOD: 0-8% slopes FAIR: 8-15% slopes POOR: stony areas	GOOD: openland, woodland POOR: openland on stony areas VERY POOR: wetland	FAIR: moderately coarse texture	Moderate to moderately rapid permeability, deep water table, slope	Well drained, moderate to moderately rapid permeability, deep water table, stones, stable trench walls
2	CHARLTON ASSOCIATION, moderately steep and steep												
	Charlton	65	SEVERE: slope, stony areas 2/	SEVERE: slope, stony areas	SEVERE: slope, stony areas	SEVERE: slope, moderately rapid permeability, stony areas	SEVERE: slope, stony areas	SEVERE: slope, stony areas	POOR: slope, stony areas	GOOD: woodland FAIR: openland POOR: openland on stony areas VERY POOR: wetland	FAIR: moderately coarse texture	Moderate to moderately rapid permeability, deep water table, slope	Well drained, moderate to moderately rapid permeability, slope deep water table, stones, stable trench walls
3	CHESHIRE ASSOCIATION, level through sloping												
	Cheshire	70	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas 2/	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas	SLIGHT: 0-3% slopes MODERATE: 3-8% slopes SEVERE: 8-15% slopes, stony areas	SEVERE: moderately rapid permeability, stony areas	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas	GOOD: 0-8% slopes FAIR: 8-15% slopes POOR: stony areas	GOOD: openland, woodland POOR: openland on stony areas VERY POOR: wetland	FAIR: moderately coarse texture	Moderate to moderately rapid permeability, deep water table, slope	Well drained, moderate to moderately rapid permeability, deep water table, stones, stable trench walls
4	CHESHIRE ASSOCIATION, moderately steep and steep												
	Cheshire	70	SEVERE: slope, stony areas 2/	SEVERE: slope, stony areas	SEVERE: slope, stony areas	SEVERE: slope, moderately rapid permeability stony areas	SEVERE: slope, stony areas	SEVERE: slope, stony areas	POOR: slope, stony areas	GOOD: woodland FAIR: openland POOR: openland on stony areas VERY POOR: wetland	FAIR: moderately coarse texture	Moderate to moderately rapid permeability, slope, deep water table, stones, stable trench walls	
5	BROADBROOK-RAINBOW ASSOCIATION, level through sloping												
	Broadbrook	40	SEVERE: slow permeability, stony areas	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas	SLIGHT: 0-3% slopes MODERATE: 3-8% slopes SEVERE: 8-15% slopes, stony areas	SLIGHT: 0-15% slopes SEVERE: stony areas	SLIGHT: 0-8% slopes MODERATE: 8-15% slopes SEVERE: stony areas	SLIGHT: picnic areas - 0-8% slopes MODERATE: picnic areas - 8-15% slopes MODERATE: camp areas-slow permeability SEVERE: stony areas	GOOD: 0-8% slopes FAIR: 8-15% slopes POOR: stony areas	GOOD: openland, woodland POOR: openland on stony areas VERY POOR: wetland	GOOD	Deep water table, slow permeability in substratum, slope	Well drained, slow permeability in substratum, deep water table, seepage in cuts, stones, stable trench walls

1/ Ratings for stony areas are for extremely stony conditions (class 3 stoniness).
2/ Hazard of ground water contamination.

TABLE 5. COMMON SOIL USE PROBLEMS BY SUBREGION

Soil Problem	Subregion								
	1	2	3	4	5	6	7	8	9
Shallowness to bedrock	X	X	X	X	X	X			
Presence of slowly permeable fragipan	X	X	X	X	X	X	X	X	X
Steepness of slope	X	X	X	X	X	X	X		
Stoniness	X	X	X	X	X	X			
Droughtiness	X	X	X	X	X	X	X	X	X
Wetness	X	X	X	X	X	X	X	X	X
Irregular topography						X	X	X	X

APPENDIX A

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APPENDIX B

GLOSSARY

Alluvium. Sediments deposited by rivers and streams which overflow their banks. The area in which alluvium is deposited by streams is the flood plain.

Basalt. A dense, hard, dark-colored rock formed from lava flows.

Bedrock. The solid rock underlying soils and geologic materials at depths ranging from zero (where exposed) to several hundred feet.

Consistence. The combination of properties of soil material that determines resistence to crushing and its ability to be molded or changed in shape. Consistency depends mainly on the forces of attraction between soil particles. Terms commonly used to describe consistency are as follows:

> Firm. When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
>
> Friable. When moist, crushes easily under moderate pressure between thumb and forefinger, and coheres when pressed together.
>
> Loose. Noncoherent, crumbles under very slight pressure.

Crystalline rock. A general term used for rocks composed of crystals or parts of crystals.

Deposit. Material left in a new position by a natural transporting agent such as water, wind, ice, or gravity or by the activity of man.

Esker (geological). A narrow ridge or mound of gravelly and sandy drift deposited by a small glacial stream.

Flood plain. The land bordering a stream, consisting of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

Fragipan (hardpan). Compact layer of soil rich in silt and sand, and low in clay. The fragipan commonly interferes with water and root penetrations. When dry, the material appears to be cemented, but when moist, it is brittle and breaks suddenly under pressure.

Glacial drift. Earth and rock materials picked up, mixed, crushed, transported, and deposited by glacial ice or by water melted from the glacial ice.

Glacial till. Earth and rock materials picked up, mixed, crushed, transported, and deposited by glacial ice.

Gneiss. A crystalline rock in which the component minerals are arranged in in parallel bands or layers.

Granite. Light colored crystalline rock that is coarse grained and composed mainly of quartz and feldspar.

Horizon, soil. A layer of soil approximately parallel to the soil surface with characteristics produced by soil-forming processes.

Kame (geological). A short, irregular ridge of stratified glacial drift.

Landscape. All the natural features such as fields, hills, forests, water, etc. which distinguishes one part of the earth's surface from another.

Mapping unit, soil. A soil phase, soil association, or other appropriate unit shown on a soil map and identified by a numerical or letter symbol.

Moraine, terminal. Earth and rock material moved by glaciers and deposited at the farthest penetration of the ice sheet.

Mottling, soil. Contrasting color patches that vary in number and size.

Organic soil. A soil which contains a high percentage (more than 20%) of organic matter.

Parent material. The unconsolidated mass of soil and rock material from which the soil has formed.

Permeability. That quality of the soil that enables water or air to move through it.

Phase, soil. A subdivision of soil series, based on features that affect its management, but do not affect its classification. Texture, steepness of slope, number of rock outcrops, thickness of soil over parent material, and natural drainage are examples of characteristics that suggest dividing a soil into phases.

Profile, soil. A verticle section of the soil through all its horizons and extending into the parent material.

Schist. A rock that has been highly altered by heat and pressure within the earth's crust. It has parallel or foliated structure and cleaves rapidly.

Sedimentary rock. A rock composed of particles deposited in water and cemented together. The principal groups are conglomerates (from gravels), sandstones (from sand), and shales (from silts).

Series, soil. A group of soils that are similar in profile characteristics and in horizon arrangement. The soils of one series have developed from a particular type of parent material.

Soil. The natural medium composed of organic and mineral materials, suitable for the growth of land plants on the surface of the earth.

Soil association. A mapping unit used on general soil maps in which one, two, or three major soils occur geographically in a characteristic repeating pattern .

Soil depth. Refers to the depth from the surface to the underlying bedrock.

Deep. A soil more than 40 inches to bedrock.

Shallow. A soil less than 20 inches to bedrock.

Soil drainage. Refers to the rapidity and extent of the removal of water from the soil, in relation to additions, especially by surface runoff and by flow through the soil to underground spaces.

Excessively drained. Water is removed from the soil very rapidly.

Well drained. Water is removed from the soil readily but not rapidly.

Moderately well drained. Water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time. The soil has a water table and is mottled in the lower part of the profile.

Poorly drained. Water is removed from the soil so slowly that it remains wet for a large part of the time. The soil has a high water table and is generally mottled from the surface downward.

Very poorly drained. Water is removed from the soil so slowly that the soil is permanently wet. The soil has a water table at the surface and has a gray color throughout.

Soil map. A map showing the distribution of soil phases, soil associations, or other soil mapping units.

Detailed. A soil map in which the kinds of mapping units are mainly phases of soil series. Scale of soil map is generally 4 inches equals one mile (1:15,840). Used for operational planning purposes.

General. A soil map in which the mapping units are mainly associations of soil series. Scale of soil map is 2 inches equals one mile (1:24,000), 1 inch equals one mile (1:62,500) or smaller. Used for broad scale and general planning purposes.

Soil survey. The systematic examination, description, classification, and mapping of soils in an area.

Soil texture. Refers to the relative proportions of the various soil separates (sands, silt, and clay) in a soil. Twenty-one textural classes are recognized by the U.S. Department of Agriculture.

Stony. Containing sufficient stones to interfere with or to prevent tillage.

Surficial (geological). The unconsolidated sediments that overlie the bedrock.

Terrace (geological). An old alluvial plain, generally flat or undulating, bordering a river, lake, or the sea; seldom subject to overflow by the adjacent body of water.

Upland (geological). Land consisting of materials unworked by water in recent geological time and ordinarily lying at a higher elevation than the flood plain or stream terrace.

Water table. The upper limit of the soil that is wholly saturated with water. In some places a perched water table may be separated from a lower one by a seasonally unsaturated zone.

APPENDIX C

SIGNIFICANT ENGINEERING SOIL PROPERTIES

Table C-1 illustrates the type of soil properties that have been estimated for each of the major soils. The column headings are described below:

Column 1. Soil Names and Associations in which They Occur. The soils are listed in alphabetical order along with the association numbers in which they occur.

Column 2. Depth (feet) to Bedrock. The depth in feet from the surface to bedrock is indicated in this column.

Column 3. Depth (feet) to Seasonal Water Table. This is the depth in feet from the surface to a seasonal high water table. During the year, free water saturates most soils to varying depths. This depth is determined largely by soil color patterns. The duration of the water table at a given level varies with the season and is not considered in this column.

Column 4. Hydrologic Group. Four groups are used in watershed planning to estimate runoff from rainfall. Soil properties are considered that influence the minimum rate of infiltration obtained for a bare soil after prolonged wetting. Dual groups are given for most of the soils that have bedrock within 20 inches of the surface.

Column 5. Percolation Rate Class. Percolation rate refers to the movement of water through the soil away from the water filled percolation test hole. It is expressed in four classes as follows:

Class	Probability	Minutes Per Inch
Fast	80% chance that rate will fall	< 5
Probably fast	50% chance that rate will fall in or above	10-20
Probably slow	50% chance that rate will fall in or below	10-20
Slow	80% chance that rate will fall	> 30

Column 6. Depth (inches) from Surface. Depths from the surface of a representative profile are given in inches.

Columns 7 & 8. Material Classification. Two classification systems are presented: the USDA system used by the United States Department of Agriculture in determining the textural classes of soils and the Unified system used by engineers.

Column 9. Permeability. The property of a soil which permits water to move through it under saturated conditions is called its permeability. Permeability is measured in inches per hour.

Column 10. Subsoil Erodibility Class. Erodibility refers to the rate that soil will erode when other factors affecting erosion are constant. For this study, low, moderate, and high erodibility classes are recognized. The classes used are related to annual losses in tons per acre.

Column 11. Biochemical Renovation Potential. This column indicates the estimated potential of the soils to renovate surface applied leachate through biochemical action. It is based on experimental results of selected soils and is expressed in relative terms of low, moderate, and high.

TABLE C-1. ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING USES

Soil Names and Associations in which they occur	Depth (feet) to Bedrock	Depth (feet) to Seasonal Water Table	Hydrologic Group	Percolation Rate Class	Depth (inches) from Surface	Material Classification U.S.D.A. Texture	Material Classification Unified System	Permeability (in./hr.)	Subsoil Erodibility Class	Biochemical Renovation Potential
1	2	3	4	5	6	7	8	9	10	11
Beaches 36	Usually >10	Daily tidal fluctuation	A	Fast	Variable	s,cos	SP,SW	>6.0	Low	Low
Berryland 20	Usually >10	0-0.5	D	1/	0-10 10-72	s s	SP,SP-SM SP,SP-SM	2.0-6.0 >6.0	Low	1/
Branford 21	Usually >10	Usually >4	B	Fast	0-24 24-60	sil,vfsl gs,vgs	ML SP,SP-SM,GP, GP-GM	0.6-0.2 >6.0	High	Moderate
Broadbrook 5	Usually >10	Usually >4	C	Slow	0-24 24-60	sil gfsl,gl,gsl	ML SM,ML	0.6-2.0 >0.2	Moderate	High
Carver 22,23	Usually >10	Usually >4	A	Fast	0-25 25-50	s,cos cosagr	SP,SW SP,SW	>6.0 >6.0	Low	Low
Charlton 1,2,12,13	Usually >10	Usually >4	B	Probably fast	0-24 24-60	fsl gfsl,gsl	SM,ML SM	0.6-6.0 0.6-6.0	Moderate	Moderate
Cheshire 3,4,14,15,18,19	Usually >10	Usually >4	B	Probably fast	0-26 26-60	fsl,sil gsl,gfsl	SM,ML SM	0.6-6.0 2.0-6.0	Moderate	Moderate
Dune Land 36	Usually >10	Usually >4	A	Fast	0-60	s,fs	SP	>6.0	Low	Low
Ellington 21	Usually >10	1.5-3.5	B	Fast	0-24 24-60	sil gs,vgs	ML SP,SP-SM,GP, GP-GM	0.6-2.0 >6.0	High	Low
Enfield 27	Usually >10	Usually >4	B	Fast	0-24 24-60	sil,vfsl gs,vgs	ML SP,GP,SP-SM, GP-GM	0.6-2.0 >6.0	High	Moderate
Haven 24,25,31	Usually >10	Usually >4	B	Fast	0-28 28-40	l,sil gs,vgs	ML SP,GP	0.6-2.0 >6.0	High	Moderate
Hinckley 26	Usually >10	Usually >4	A	Fast	0-10 10-18 18-60	sl,ls,gsl, gls,fsl gls gs,vgs	SM,ML SM,GM,GP-GM SP,SP-SM,GP, GP-GM	>6.0 >6.0 >6.0	Low	Low
Hollis 12,13,16,17	< 2	Usually >4	C/D	2/	0-15 15+	fsl bedrock - - - - - - - - - - - - - -	SM,ML	2.0-6.0	Moderate	2/
Holyoke 14,15,18,19	< 2	Usually >4	C/D	2/	0-15 15+	sil bedrock - - - - - - - - - - - - - -	ML	0.6-2.0	Moderate	2/
Leicester 9	Usually >10	0-1.5	C	1/	0-32 32-60	fsl,sl,gsl fsl,gfsl,gsl	SM,ML SM,GM	0.6-6.0 2.0-6.0	Moderate	1/
Limerick 33	Usually >10	0-1.5	C	1/	0-10 10-60	sil,vfsl sil,vfsl	ML,OL,ML-CL ML,ML-CL	0.6-2.0 0.6-2.0	High	1/
Ludlow 10	Usually >10	1.5-3.5	C	Slow	0-24 24-60	l,sil gl,gsil,l	ML,ML-CL ML,ML-CL	0.6-2.0 <0.2	Moderate	High
Manchester 28	Usually >10	Usually >4	A	Fast	0-10 10-18 18-60	sl,ls,gsl, gls,fsl gls gs,vgs	SM,ML SM,GM,GP-GM SP,SP-SM,GP	>6.0 >6.0 >6.0	Low	Low
Menlo 11	Usually >10	0	D	1/	0-24 24-60	l,sil l,sil,gsil, fsl	ML,ML-CL SM,ML,ML-CL	0.6-2.0 <0.2	Moderate	1/
Merrimac 27	Usually >10	Usually >4	A	Fast	0-15 15-26 26-60	fsl,sl sl,ls gs,vgs	SM,ML SM,SP-SM SP,SP-SM,GP, GP-GM	2.0-6.0 2.0-6.0 >6.0	Moderate	Low
Montauk 6,25	Usually >10	Usually >4	C	Slow	0-27 27-60	fsl,l,sl ls,sl,fsl	SM,ML SM	0.6-6.0 <0.2	Moderate	High
Palms 34	Usually >10	0	D	1/	0-40 40-60	organic fsl,cl	Pt SM,ML,OH,OL	2.0-6.0 0.6-2.0	Low	1/

1/ Not estimated for poorly drained and very poorly drained soils with seasonal high water tables.
2/ Not estimated for shallow soils less than 20 inches deep over bedrock.

APPENDIX D

INTERPRETATIONS OF SOILS FOR VARIOUS USES

Table 4, in the main report, illustrated the type of interpretative information on file for each soil association and major soil. This appendix provides a detailed explanation of each column in Table 4.

Column 1. Map Symbol. The map symbols are listed in numerical order.

Column 2. Soil Association and Major Soils. The soil associations and names of the major soils are listed. Soil names are subject to change pending final correlation when the detailed soil survey is completed.

Column 3. Percent of Association. The percent of the association consisting of each major soil is estimated in this column.

Column 4. Degree and kinds of limitations for Septic Tank Absorption Fields. In making interpretations of soil properties for on-site sewage disposal, the limitations denote problems in location, construction, design, and performance. The design and performance of a waste disposal system connot be based solely on a soil percolation test. In order to make accurate estimates of performance, judgments must be made of such factors as water table, fragipan, bedrock depth, slope, stoniness, rock outcrops, and flooding hazards. Further, the estimates do not take into account the competence of installation, because failures due to errors in judgment and poor workmanship may occur regardless of soil and site conditions.

Column 5. Degree and kinds of limitations for Sites for Houses with Basements. In evaluating soil properties for homesite locations with basements, the limitations denote problems in excavation, stability of footings, installations, and performance of footing drains. Severity of limitations may be determined by bedrock, stoniness, slumping, lateral seepage of water over fragipan, surface ponding, and slope.

Column 6. Degree and kinds of limitations for Commercial and Light Industry Sites. In evaluating soil properties for commercial and industrial sites, the limitations denote problems in excavation, installation, performance of footing drains, and stability. Evaluation of the limitations may be determined by slope, water table, bedrock, flooding hazard, lateral seepage of water over fragipan, stoniness, slumping, and surface ponding.

Column 7. Degree and kinds of limitations for Sanitary Land Fill. The evaluation of soil properties for trench type sanitary land fill considers the quality of the site. A good sanitary land fill should operate without contaminating water supplies, reducing land values, or causing health hazards. In addition, it should be usable during all seasons of the year. The soil properties used to evaluate trench type land fill sites are depth to seasonal

high water table, soil drainage class, flooding hazard, permeability, slope, soil texture, depth to bedrock, stoniness, and rockiness. No importation of fill or cover material is considered in the ratings.

Column 8. Degree and kinds of limitations for Waste Water Renovation. Each major soil is rated by degree of limitation according to current knowledge. To rate each soil, such properties as biochemical renovation potential, soil texture, depth to water table, depth to bedrock, surface stoniness, and flooding must be evaluated collectively.

Column 9. Degree and kinds of limitations for Camp and Picnic Areas. The evaluation of soil properties for camp and picnic areas applies to soils used intensively for park type picnic areas and sites for tent and small camp trailers. The soils should be suited for heavy foot traffic and for limited vehicular traffic. Soil properties evaluated are wetness, flooding, permeability, slope, surface soil texture, coarse fragments, stoniness, and rockiness.

Column 10. Suitability ratings for Cropland. The evaluation of soil properties for cropland applies to soils used to grow crops common to the area. Evaluations are based on using a high level of management. The soils should hold sufficient available water, be easy to till, have good natural drainage, respond well to fertilization, be deep and free of stones, and have level or gentle slopes. Ratings are in terms of good, fair, and poor.

Column 11. Suitability ratings for Wildlife Habitat. Soil suitability is an important factor for producing desired populations of wildlife. Factors such as present land use and existing wildlife populations are not considered in these ratings. The ratings deal with the relationships between kinds of soils and kinds of plant and water developments that support wildlife habitat. Each soil is rated for its suitability to produce, improve, or maintain specific habitats. The wildlife habitats rated are openland wildlife habitat, woodland wildlife habitat, and wetland wildlife habitat. Ratings are in terms of good, fair, poor, and very poor.

Column 12. Woodland Productivity Potential. Soil evaluations for woodland production applies to soils used to grow the tree species that are favored locally. Equipment limitations vary according to slope, stoniness, rockiness, and wetness. Soil properties evaluated are drainage, slope, permeability, fragipan, shallowness to bedrock, stoniness, and rockiness. Ratings are in terms of good, fair, poor, and very poor. Potential productivity is based on the site index. Site index refers to the average height attained by the dominant trees at the age of 50 years.

Column 13. Soil features affecting Pond Reservoir Areas. The evaluation of soils for pond reservoir areas applies to those features and qualities that affect the suitability of undisturbed soils for water impoundment. These are permeability, depth to water table, depth to bedrock or sand and gravel, and slope.

Column 14. Soil features affecting Transportation, Utility Corridors, and Construction Sites. The evaluation of soils for these uses applies to features affecting highway and industrial construction and utility corridors. The primary soil features considered are depth to water table, susceptibility to frost heave, erodibility, stability, seepage, flooding, depth to bedrock, stoniness, texture, and permeability.

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LONG ISLAND SOUND REGIONAL STUDY
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Connecticut Office of State Planning	Horace Brown
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